

## **Releases of Exotic Natural Enemies for the Biological Control of Yellow starthistle in California, 1984 through 2002**

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Six insect species have been introduced into the United States for the biological control of Yellow starthistle (YST), *Centaurea solstitialis* L. These insects include two seedhead gall flies, *U. sirunaseva* (Hering), and *Urophora jaculata* Rondani, a seed feeding fly, *Chaetorellia australis* Hering, and three weevils: *Bangasternus orientalis* (Cap.), the YST seedhead weevil, *Eustenopus villosus* (Boheman), the hairy weevil, and *Larinus curtus* Hochhut, the YST flower weevil. An additional species, *Chaetorellia succinea* (Costa) was mistakenly introduced as *Chaetorellia australis* in 1991. It quickly became established and has become an important natural enemy of YST in the western states of California, Idaho, Nevada, Oregon, and Washington. It was justly named the false peacock fly.

In order to manage releases of these insects, the Biological Control Program, the County Agricultural Commissioners and Sealers Association and the United States Department of Food and Agriculture, Agricultural Research Service initiated a cooperative redistribution program in 1988. Newly introduced biological control agents were quickly released in California and once the insects were well established, collection workshops were set up at available sites and county personnel attending the workshops were able to collect their own biological control agents for release in county nursery sites. The county nursery sites were then monitored and when the insects were well established, personnel from that particular county were able to collect and redistribute the insects elsewhere in that county. Regional collection sites in Amador, El Dorado, Nevada, Placer, Sacramento, Shasta, Siskiyou, and Tulare counties were used for supplying insects to the rest of the counties in California. Additionally, counties like Amador, El Dorado, Glenn, Monterey, Napa, Placer, San Benito, Shasta, Trinity, and Tulare and have organized in-county redistribution collections and educational workshops for their county constituents.

(Table 1) summarizes all the releases that the Biological Control Program has been able to record from data forms supplied during the many collection workshops. This table, when used with distributional maps of YST in California, shows that most areas of California reporting acreage of YST have had some level of releases. This table can also be used with the recent YST survey that was done along major highways that passed through YST infested areas of California. To date, most of the workshops have been done for mass collecting the hairy weevil. A total of 1,182 individual releases have occurred in 50 counties with a grand total of 324,208 weevils released. The hairy weevil is a poor flyer and consequently distributional releases are encouraged. Only 33 releases were made with the two peacock flies, *Chaetorellia australis* and *C. succinea*. These flies are very strong fliers, particularly *C. succinea*. In field surveys conducted since it was released in 1994 through 1996, it quickly became established and moved from released areas very quickly as well. By the summer of 1999, *C. succinea* was recovered in all YST infested areas in California. This fly has also been recovered from tocalote, *Centaurea melitensis* L. and in some areas particularly in the San Joaquin Valley and Southern California; this weed might provide a bridge to isolated populations of YST.

**Table 1: Natural Enemies Released Against *Centaurea solstitialis* in California, 1984 through 2002**

County	B. orientalis		E. villosus		L. curtis		C. succinea		U. sirunaseva	
	#	#	#	#	#	#	#	#	#	#
	Insects	Releases	Insects	Releases	Insects	Releases	Insects	Releases	Insects	Releases
Alameda	785	3	1,300	6	2,500	4	0	0	0	0
Alpine	0	0	299	4	150	2	0	0	0	0
Amador	400	2	1,450	6	500	2	164	1	1,026	3
Butte	708	3	2,470	11	0	0	0	0	400	3
Calaveras	3,581	14	3,660	20	1,103	4	0	0	400	3
Colusa	335	2	800	3	0	0	0	0	0	0
Contra Costa	4,325	21	22,532	55	5,325	19	800	3	3,523	14
Del Norte	547	4	500	2	0	0	0	0	0	0
El Dorado	2,899	13	9,661	42	0	0	200	1	1,084	4
Fresno	1,400	4	4,050	13	0	0	300	1	1,300	5
Glenn	5,125	23	17,320	60	1,000	4	700	2	675	6
Humboldt	4,255	15	6,175	25	1,350	2	0	0	520	5
Imperial	0	0	0	0	0	0	0	0	0	0
Inyo	0	0	0	0	0	0	0	0	0	0
Kern	500	4	4,755	25	600	3	0	0	300	2
Kings	200	2	1,910	9	0	0	0	0	300	2
Lake	1,270	7	1,720	4	400	2	0	0	200	2
Lassen	408	2	3,470	16	200	1	0	0	0	0
Los Angeles	297	1	2,367	5	0	0	0	0	0	0
Madera	900	5	254	1	0	0	200	1	200	2
Marin	1,469	11	3,285	14	450	2	300	1	200	2
Mariposa	523	3	1,065	5	0	0	1,151	4	0	0
Mendocino	2,750	17	3,484	12	200	1	0	0	3,342	19
Merced	710	5	22,363	10	500	2	0	0	405	3
Modoc	600	4	1,350	6	0	0	0	0	200	1
Monterey	650	4	23,865	77	3,685	14	0	0	400	3
Mono	0	0	0	0	0	0	0	0	0	0
Napa	2,390	13	10,849	35	1,200	3	770	2	4,369	14
Nevada	3,924	25	400	2	200	1	322	2	200	1
Orange	0	0	0	0	0	0	0	0	0	0
Placer	2,470	21	3,765	20	580	3	460	2	1,169	5
Plumas	1,550	8	6,150	25	225	1	42	1	0	0
Riverside	300	1	700	5	0	0	0	0	0	0
Sacramento	750	4	7,516	24	1,350	4	972	2	425	2
San Benito	1,100	6	5,460	22	200	1	0	0	400	2
San Bernardino	0	0	0	0	0	0	0	0	0	0
San Diego	0	0	0	0	0	0	0	0	0	0
San Francisco	0	0	0	0	0	0	0	0	0	0
San Joaquin	1,179	5	1,550	7	0	0	0	0	680	4
San Luis	3,081	20	9,765	21	0	0	560	1	3,450	13
Obispo										
San Mateo	1,160	6	915	5	0	0	0	0	850	5
Santa Barbara	200	1	9,135	23	1,077	2	800	2	600	3
Santa Clara	1,885	8	5,902	27	358	2	0	0	450	3
Santa Cruz	216	1	0	0	0	0	0	0	0	0
Shasta	5,697	30	38,575	183	600	3	794	3	6,050	20
Sierra	250	1	650	4	200	1	0	0	0	0
Siskiyou	1,399	7	2,100	10	400	2	500	1	550	3
Solano	1,425	9	2,500	9	400	1	0	0	1,451	8
Sonoma	3,343	14	10,216	46	3,500	16	0	0	1,890	7
Stanislaus	1,024	6	6,750	20	0	0	0	0	1,158	3
Sutter	425	2	5,280	22	270	1	300	1	0	0
Tehama	2,025	14	11,920	54	600	3	0	0	200	2
Trinity	4,188	22	8,605	41	1,000	3	0	0	700	4
Tulare	365	3	23,475	101	500	2	300	1	300	2
Tuolumne	934	4	2,387	10	0	0	0	0	300	2
Ventura	0	0	630	2	0	0	0	0	0	0
Yolo	4,323	19	4,608	12	800	4	400	1	1,126	5
Yuba	1,331	9	4,300	21	200	1	0	0	1,200	2
<b>Total Releases</b>	<b>81,571</b>	<b>428</b>	<b>324,208</b>	<b>1,182</b>	<b>31,623</b>	<b>116</b>	<b>10,035</b>	<b>33</b>	<b>41,993</b>	<b>189</b>
<b>No. Counties</b>	<b>49</b>		<b>50</b>		<b>33</b>		<b>20</b>		<b>38</b>	